City of Riverside

WASTEWATER COLLECTION AND TREATMENT FACILITIES INTEGRATED MASTER PLAN

VOLUME 9: ENERGY MANAGEMENT
CHAPTER 1: EXISTING ENERGY SYSTEMS

FINAL
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City of Riverside

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CHAPTER 1: EXISTING ENERGY SYSTEMS

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EXISTING ENERGY SYSTEMS

1.1 PURPOSE

The purpose of this chapter is to summarize the existing energy systems at the City of Riverside (City) Regional Water Quality Control Plant (RWQCP).

1.2 BACKGROUND

The RWQCP is a tertiary wastewater treatment plant that currently treats approximately 33 mgd on an average annual (AA) basis. The RWQCP has a rated capacity of approximately 40-mgd AA. The City seeks to develop an Integrated Master Plan for the Wastewater Systems Facilities to identify and plan for expansion and replacement needs for up to the year 2025. Energy systems are an integral part of the RWQCP operation. With proper planning and appropriate implementation of energy system improvements, the RWQCP will reduce the need for outside sources of energy (power and natural gas) and be able to cost effectively treat and dispose of wastewater solids.

1.3 EXISTING ENERGY SYSTEMS

The energy systems of the plant consist of an electrical power system, a natural gas system, a digester heating system, and a digester gas system.

1.3.1 Existing Power System

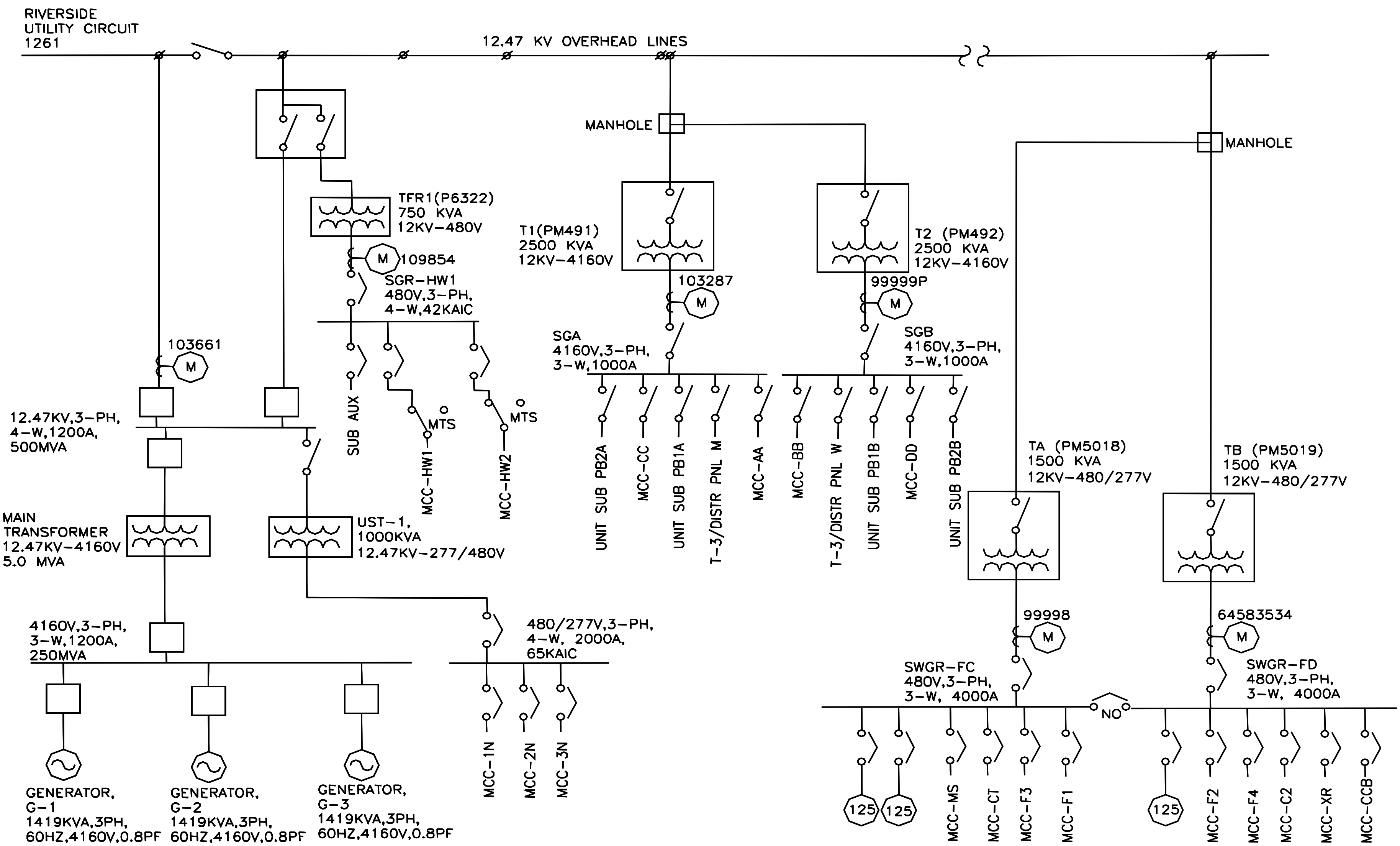
The RWQCP receives normal power from the Riverside Public Utility electrical grid and in-plant cogeneration system. The existing RWQCP electrical configuration and distribution plan are shown on Figures 1.1 and 1.2, respectively.

The Riverside Public Utility provides two feeds into the plant's single 12-kV overhead line. These two feeds originate from the same utility substation and only the feed coming into the plant entrance on Acorn Street is in service. The other feed is disconnected and is used as a backup when the Acorn feed is out of service for maintenance.

In normal operation, the plant cogeneration system provides half of the plant current total load of approximately 3,000 kW, with the balance provided by the Riverside Public Utility.

1.3.1.1 Electrical Distribution System

The plant power sources (utility and cogeneration system) distribute power to the RWQCP's substations through a single common 12-kV overhead line. The substations step down the voltage to 4.16 kV or 480 volts, depending on the system. Except for the headworks facility, the existing in-plant substations are designed in a double-ended configuration and feed



EXISTING RWQCP ELECTRICAL CONFIGURATION

FIGURE 1.1

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FACILITIES INTEGRATED MASTER PLAN

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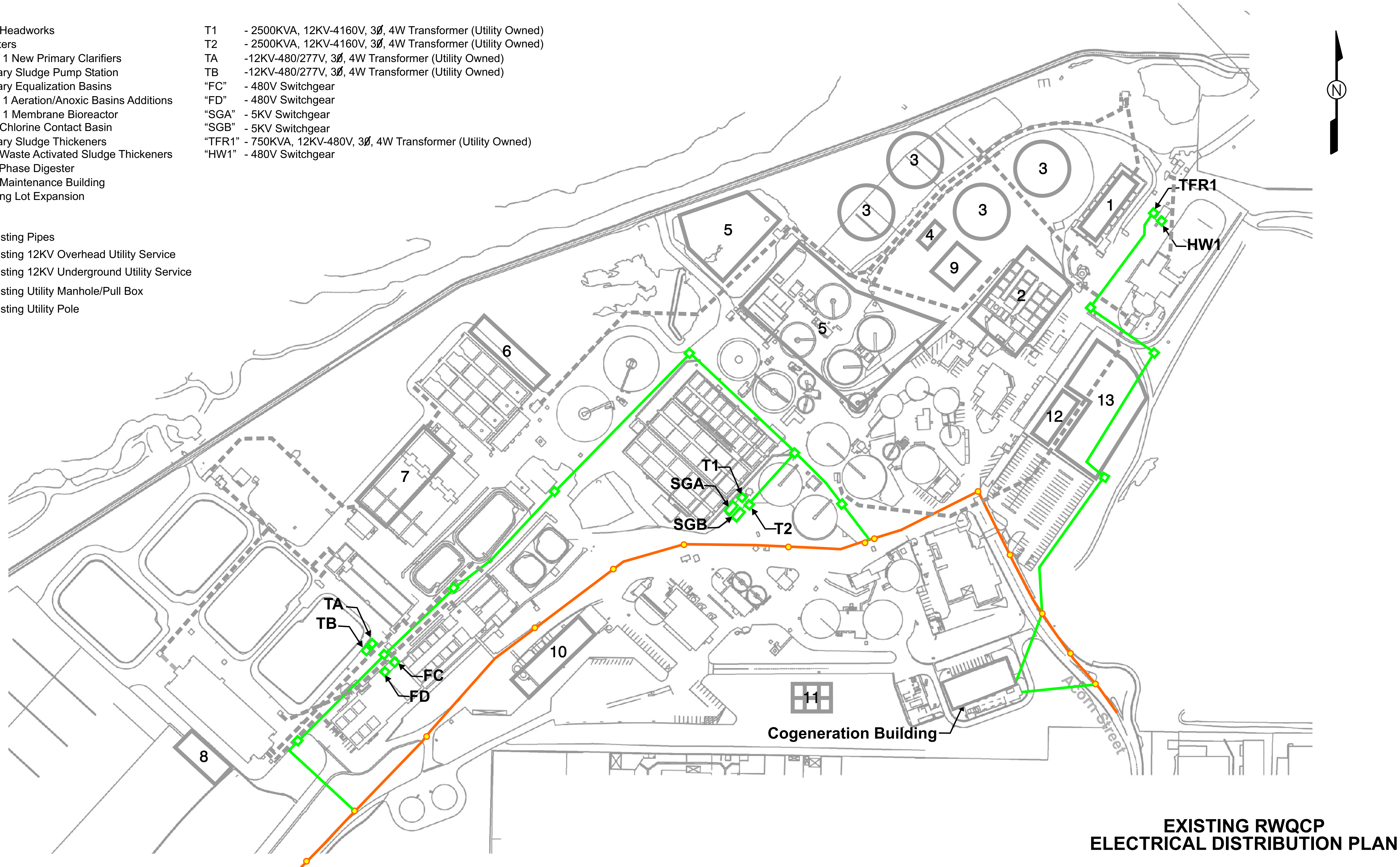
Key

1. New Headworks
2. Biofilters
3. Plant 1 New Primary Clarifiers
4. Primary Sludge Pump Station
5. Primary Equalization Basins
6. Plant 1 Aeration/Anoxic Basins Additions
7. Plant 1 Membrane Bioreactor
8. New Chlorine Contact Basin
9. Primary Sludge Thickeners
10. New Waste Activated Sludge Thickeners
11. Acid Phase Digester
12. New Maintenance Building
13. Parking Lot Expansion

T1	- 2500KVA, 12KV-4160V, 3Ø, 4W Transformer (Utility Owned)
T2	- 2500KVA, 12KV-4160V, 3Ø, 4W Transformer (Utility Owned)
TA	-12KV-480/277V, 3Ø, 4W Transformer (Utility Owned)
TB	-12KV-480/277V, 3Ø, 4W Transformer (Utility Owned)
"FC"	- 480V Switchgear
"FD"	- 480V Switchgear
"SGA"	- 5KV Switchgear
"SGB"	- 5KV Switchgear
"TFR1"	- 750KVA, 12KV-480V, 3Ø, 4W Transformer (Utility Owned)
"HW1"	- 480V Switchgear

Legend

- Existing Pipes
- Existing 12KV Overhead Utility Service
- Existing 12KV Underground Utility Service
- Existing Utility Manhole/Pull Box
- Existing Utility Pole



EXISTING RWQCP ELECTRICAL DISTRIBUTION PLAN

FIGURE 1.2

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different Motor Control Centers (MCC) or Switchboards (SWBD) in their respective areas. The existing headworks facility is currently fed from a single substation, but has the provision for a future second substation, which if installed, would provide a double-ended configuration.

1.3.1.2 Standby Power System

The existing RWQCP cogeneration facility was designed to provide cogeneration and backup standby power through the controls in the plant Supervisory Control and Data Acquisition (SCADA) system. However, the backup standby power controls were not implemented in the plant SCADA system.

Currently, when the utility power fails, the cogeneration will shut down and the plant will not have any power except for the headwork facilities, which is provided with portable standby generator hook-ups.

1.3.1.3 Cogeneration System

The RWQCP cogeneration system consists of three Caterpillar gas-fired lean-burn reciprocating engine generators. These engines are fueled by a combination of digester gas and natural gas, with digester gas being the primary fuel source and natural gas being used only when digester gas is not available.

The RWQCP is within the jurisdiction of the South Coast Air Quality Management District (SCAQMD). The cogeneration engines are subject to current emissions limits as shown in Table 1.1.

Table 1.1 Emission Limits for Existing Cogeneration Engines[1]
Wastewater Collection and Treatment Facilities Integrated Master Plan
City of Riverside

Air Contaminant	Emission Limit, lbs/hour each
Reactive Hydrocarbons	2.1
Nitrogen Oxide, as NO_x	2.3
Sulfur Dioxide	0.4
Carbon Monoxide	8.0
PM10 Particulate Matter	1.0

Notes:
(1) Information extracted from Table 6 of the 2003 Bio-Solids Handling Improvements Report; refer to Volume 8, Chapter 2 - Summary of Planning Studies.

The engines are equipped with a continuous emission-monitoring system to ensure compliance with the NO_x emissions limit.

SCAQMD is revising the emission regulations associated with engine generators. The revised Rule 1110.2 requirements significantly lower NOx, Volatile Organic Compound (VOC), and Carbon Monoxide (CO) emission requirements. Although the rule is not final yet, the proposed limits are listed in Table 1.2. The revised rule requires all existing engines to either be retrofitted to meet these requirements or shut down, by 2012. Retrofitting to meet the revised requirement will require the addition of a Selective Catalytic Reduction (SCR) system and a CO oxidation catalyst. In order for these to work, with digester gas, a gas conditioning system will be required to remove all siloxane and sulfur compounds.

Table 1.2 SCAQMD Propose Rule 1110.2 Emission Limits for Existing Engines
Wastewater Collection and Treatment Facilities Integrated Master Plan
City of Riverside

Air Contaminant	Emission Limit, ppm
NO_x	11
VOC	30
CO (fueled with natural gas)	70
CO (fueled with 90% or more digester/landfill gas)	250

Notes:
(1) From SCAQMD Rule 1110.2 (proposed) January 23, 2007.

The RWQCP has indicated that the existing cogeneration engines will be retrofitted to be fueled exclusively by natural gas. They will then be used as standby generators for the RWQCP.

To replace the cogeneration capacity that will be lost by converting the cogeneration engines to a standby power source, the RWQCP is currently installing a 1,000-kW fuel cell installation, using digester gas as the fuel source. The RWQCP staff has also indicated that an additional 1,200-kW fuel cell installation is planned to be added following successful operation of the first fuel cell system. The addition fuel cells would be added before the cogeneration engines are retrofitted in 2012.

1.3.2 Existing Natural Gas System

A summary of the existing natural gas system at the RWQCP was included in Volume 4, Chapter 11 - Plant Utilities and Support Facilities.

Natural gas is currently used as supplemental fuel for the cogeneration engines as well as for miscellaneous uses throughout the plant for space and domestic water heating and uses within the laboratory. 2006 natural gas usage data, as well as information provided by RWQCP staff, indicate that on average 9,500 therms/month are used by the cogeneration engines. This value typically ranges from 7,000 to 12,000 therms/month. The other non-cogeneration uses account for an average of 535 therms/month.

Current 2006 average natural gas costs averaged $0.90/therm for cogeneration usage and $1.03/therm for non-cogeneration uses.

1.3.3 Existing Digester Heating System

A summary of the existing digester heating system at the RWQCP was included in the 2003 Bio-Solids Handling Improvements Report. Refer to Volume 8, Chapter 2 - Summary of Planning Studies. In general, the cogeneration system supplies the heat for the digesters. Standby boilers are used when the cogeneration system is not operation.

Current average digester heating requirements are estimated at 3,255,000 Btu/hr with peak heat demand of 5,077,000 Btu/hr. The RWQCP currently accepts Fats, Oils, and Grease (FOG) in order to augment digester gas production. 2006 testing in one of the active methane digesters shows that approximately 25,000 gallons/day per digester of FOG can be added to supplement gas production. As such, the RWQCP plans to accept FOG to digest in the two active methane digesters. The amount of FOG for the two digesters was estimated at approximately 50,000-gallons/day total based on the results of the recent testing. The final amount of FOG will be dependent on availability and on how much can be added to the digester process without negatively impacting digester operation. The added FOG entering the digesters will increase the heat demand of the digestion system by an average of 80,000 Btu/hr, with peak additional heat needed of 1,000,000 Btu/hr. The plant expects to start accepting this additional FOG waste immediately. This will increase the projected current heat demands to 4,055,000 Btu/hr, average and 6,077,000 Btu/hr, peak.

1.3.4 Existing Digester Gas System

A summary of the existing digester gas system at the RWQCP was included in the 2003 Bio-Solids Handling Improvements Report. Refer to Volume 8, Chapter 2 - Summary of Planning Studies.

Current average digester gas production was measured at approximately 325,000 standard cubic feet per day (scfd), with a peak heat demand of approximately 455,000 scfd during periods with no grease addition to the digesters. As noted previously, the RWQCP currently accepts FOG in order to augment digester gas production. 2006 testing has indicated the ability to use 25,000 gallons/day of FOG within the active methane digester. The testing indicated that the addition of FOG resulted in approximately 7.4 scfd per gallon/day of FOG. Also, as noted previously, the RWQCP plans to accept approximately 50,000-gallons/day total of FOG to digest in the two active methane digesters. This additional 50,000 gallons/day of FOG entering the digesters will increase digester gas production by an average of 370,000 scfd, with peak additional production of 480,000 scfd. The plant expects to start accepting this additional FOG immediately. This will increase the projected digester gas production to 695,000 scfd, average and 936,000 scfd, peak. RWQCP staff have indicated that the target gas production level is 1,000,000 scfd. To reach this target as average digester gas production, it is estimated that approximately 100,000 gallons/day of FOG would be required.

Table 1.3 presents the anticipated average and peak digester gas production, both with and without grease addition, through 2025. The gas production values were calculated by ratioing current 2006 values, noted above, to projected plant flows. The RWQCP plant flow estimate is from Volume 2, Chapter 3 - Population and Flow Projections.

Table 1.3 Estimated RWQCP Digester Gas Production
Wastewater Collection and Treatment Facilities Integrated Master Plan
City of Riverside

Year	Flow, mgd	No Grease: Average Gas Production, scfd	No Grease: Peak Gas Production, scfd	Grease Addition: Average Gas Production, scfd	Grease Addition: Peak Gas Production, scfd
2006	33.5	325,000	455,000	695,000	936,000
2007	34.4	334,000	467,000	704,000	948,000
2008	35.4	343,000	481,000	713,000	961,000
2009	36.4	353,000	494,000	723,000	975,000
2010	37.4	363,000	508,000	733,000	988,000
2011	38.4	373,000	522,000	743,000	1,002,000
2012	39.4	382,000	535,000	752,000	1,016,000
2013	40.0	388,000	543,000	758,000	1,024,000
2014	40.6	394,000	551,000	764,000	1,032,000
2015	41.2	400,000	560,000	770,000	1,040,000
2016	41.8	406,000	568,000	776,000	1,048,000
2017	42.4	411,000	576,000	781,000	1,056,000
2018	43.0	417,000	584,000	787,000	1,065,000
2019	43.6	423,000	592,000	793,000	1,073,000
2020	44.3	430,000	602,000	800,000	1,082,000
2021	44.9	436,000	610,000	806,000	1,090,000
2022	45.5	441,000	618,000	811,000	1,099,000
2023	46.1	447,000	626,000	817,000	1,107,000
2024	46.7	453,000	634,000	823,000	1,115,000
2025	47.3	459,000	642,000	829,000	1,123,000